Extravehicular Activity Technology Development—Suit Port Technologies

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The multi-mission space exploration vehicle and extravehicular activity (EVA) development teams have jointly developed suit port technology in support of EVAs. A suit port enables rapid vehicle egress and ingress for future space exploration vehicles. It currently takes approximately 2.5 hours of preparation time to perform an EVA from the International Space Station. A further 0.5 hour is needed to depressurize the airlock, and another 1 hour (post-EVA completion) is invested in the total before the crew member finishes with his or her EVA-related duties. The goal of the suit port is to limit the amount of crew time to fewer than 30 minutes prior to the EVA and after the EVA. Several demonstrations have been performed to mature this technology.

Fig. 1. *Desert Research and Technology Studies field testing.*

Operational Assessments

The operational scenarios associated with a suit port have been assessed with the multi-mission space exploration vehicle as part of the Desert Research and Technology Studies mission analog. These evaluations have focused on demonstrating timelines and human factors associated with integrating the suit port into the multi-mission space exploration vehicle cabin and aft bulkhead. The evaluations have been used to mature and evaluate the suit port sealing and latching designs. An example of relevant Desert Research and Technology Studies field testing is shown in figure 1.

Alignment Guide Assessments

Once the basic operational scenario and suit port technology were demonstrated, additional detailed evaluations of a suit port alignment guide were performed. Multiple concepts for aligning the Portable Life Support System into the suit port hatch were developed and tested in a laboratory setting. Alignment is important and challenging because the EVA crew member is backing up into the suit port and has limited visibilty. If the Portable Life Support System and suit port interface plate do not line up properly, the latches and seal cannot be made, which would prevent the crew member from being able to return to the vehicle. Following testing (figure 2), a simplified, low-profile concept was selected out of this study and is being used in future evaluations.

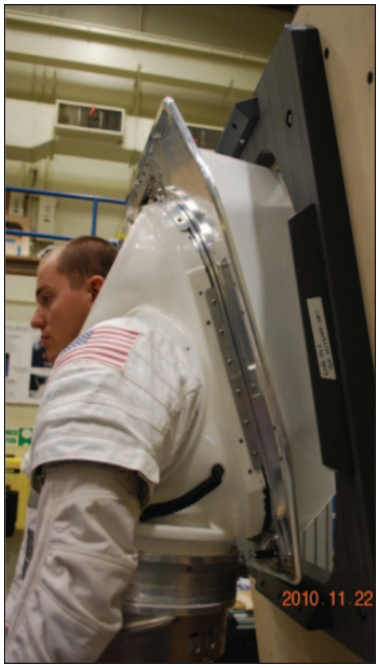

Fig. 2. *Suit port alignment testing.*

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Pressurized Evaluations

The concept of using a suit port for rapid vehicle ingress and egress impacts on development of a spacesuit in several ways. The teams undertook a number of development tasks to assess these impacts and overcome the technical challenges associated with them. First, suit port operations dictate that an exploration spacesuit be donned and doffed through a rear-entry hatch with a suit port interface plate. The suit port interface plate is the surface that makes a pressure seal with the vehicle and is clamped by the mechanisms within the suit port. A rear-entry upper torso with a suit port interface plate is under development and will be completed in 2011. Donning a suit via a suit port also means that the crew member will be entering a suit that is already pressurized. This provides additional challenges associated with making sizing adjustments to the suit because all adjustments would be made in opposition to the suit pressure. The teams developed proof-of-concept designs for gloves and boots in which sizing adjustments could be made while the suit was pressurized, and performed an ambient pressure vacuum chamber demonstration (figure 3).

Fig. 3. *Ambient pressure vacuum chamber demonstration.*